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PSD PERMIT APPLICATION
FOR NEW SOURCES TO BE
ADDED TO THE
KUPARUK, ALASKA OIL FIELD

Submitted by:
Arco Alaska, Inc.

Submitted to:
U.S. Environmental Protection Agency Region X
and the
State of Alaska
Department of Environmental Conservation

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1.0 EXECUTIVE SUMMARY

Purpose

The purpose of this document is to support an application for a permit to construct additional facilities at the Kuparuk, Alaska Oil Field in accordance with the requirements of the United States Environmental Protection Agency's (USEPA) Prevention of Significant Deterioration (PSD) regulations which were promulgated August 7, 1980. This document is presented by ARCO Alaska, Inc., a subsidiary of Atlantic Richfield Company (ARCO).

Project Description

Additional facilities will be constructed to continue the development of the Kuparuk Oil Field. These consist of additional drill sites, expansion of the existing Central Production Facility (CPF), three other production facilities, water injection facilities, additional power production capacity, and a crude oil topping unit.

Project Schedule

Commitment of funds for the project may begin as early as mid-1981 with operations starting between early 1983 and late 1988.

Air Pollution Emission Sources

Atmospheric emissions from the proposed additional facilities will be produced by heaters at the drill sites, turbines and heaters at the production facilities, and the

crude oil topping unit flare at the Central Production Facility. Total potential emissions from the proposed sources are shown below:

Pollutant	Potential Emissions (tons/year)
NO_x	15,402
PM	373
CO	3,006
SO_2	99
VOC	64

Regulatory Applicability

According to the PSD regulations promulgated on August 7, 1980, the proposed additional facilities constitute a major stationary source and are therefore subject to PSD review. The proposed facilities are also subject to Best Available Control Technology (BACT) requirements for emissions of NO_x, CO, PM, SO_2, and VOC.

BACT

A control plan which addresses BACT for each of the above-mentioned pollutants has been developed. Because NO_x is the pollutant of greatest concern in the Kuparuk area, NO_x control received primary attention. Natural gas firing and the use of dry controls will constitute BACT for turbines; natural gas firing will constitute BACT for heaters.

Air Quality Review

The Prudhoe Bay area is an attainment PSD Class II area for all criteria pollutants. The results of the air quality

impact analyses show that none of the National Ambient Air Quality Standards (NAAQS) or applicable PSD increments are exceeded as a result of emissions from the proposed additional facilities.

The pollutant of primary concern for this application is NO_2 for which there is an annual NAAQS limit of 100 $\mu g/m^3$. Dispersion modeling results indicate that the highest predicted NO_2 ground level concentration in the Kuparuk area due to all sources, including background and existing sources, is 57.8 $\mu g/m^3$.

Impacts on Visibility, Soils, Vegetation, and Induced Growth

The impacts on visibility, soils, and vegetation resulting from the emissions of the proposed additional facilities and impacts of induced growth will be negligible.

Hydrocarbons (HC) and Carbon Monoxide (CO)

Potential emissions of hydrocarbons (HC), and carbon monoxide (CO) are based on AP-42 emission factors for gas turbine compressor engines, Table 3.3.2-1 (EPA, AP-42, August 1977, p. 149). HC emissions are given as total hydrocarbons and volatile organic compounds (VOC) emissions should only comprise about 5-10 percent of this total (EPA, AP-42, August 1977, p. 149). The emission calculations are presented in Appendix B.

Particulate Matter (PM)

Emission factors for particulates from gas turbines are listed as not available in Table 3.3.2-1 of AP-42. Consequently, the factor from Table 3.3.1-2, composite emissions factors for electric utility gas turbines was used (EPA, AP-42, August 1977, p. 146).

Sulfur Dioxide (SO_2)

The emission factor used is based on an estimated fuel gas composition of 20 ppm H_2S, a maximum heat rate of 9433 Btu/hp-hr and conditions of 70°F and 1 atmosphere. Potential emissions are listed in Table 3-2. Worst-case stack characteristic assumptions are presented in Table 3-3. The detailed emissions rate calculations are presented in Appendix B.

3.4.2 Methodology for Gas-Fired Heaters

The potential emissions of NO_x, PM, CO, and HC from gas-fired heaters are based on AP-42 emission factors for natural gas combustion sources, Table 1.4-1 (EPA, AP-42, August 1977, p. 39). The emission calculations are presented in Appendix B.

5.0 BEST AVAILABLE CONTROL TECHNOLOGY

Prevention of Significant Deterioration (PSD) Regulations promulgated by the USEPA on August 7, 1980 state that a project must apply Best Available Control Technology (BACT) to each pollutant regulated under the Clean Air Act for which a proposed facility emits a "significant" amount. "Significant" in terms of net emissions increase or potential to emit means an emission rate for a proposed source that would equal or exceed the values shown in Table 5-1. For comparison, the total potential emissions for the proposed facilities are also shown in Table 5-1.

Net emission increases for CO, NO_x, SO_2, PM, and VOC from the proposed new sources exceed the significant levels. Therefore, BACT will be applied to control these emissions from the proposed facilities.

5.1 Proposed Controls Representing BACT

An analysis has been performed to determine BACT for the proposed facilities in a manner consistent with national and EPA Region X guidelines. The primary emission sources are gas-fired turbines and heaters. BACT for these sources was determined according to the precedents set in the Unit Owner's PWI/LPS/AL and Waterflood permits (Permit Nos. PSD-X-80-09 and PSD-X-81-01). The controls proposed as BACT are summarized below:

Turbines

Natural gas firing and the use of dry (internal combustion) controls is proposed as BACT.

TABLE 5-1

NET EMISSIONS INCREASES AND SIGNIFICANT LEVELS

FOR ADDITIONAL KUPARUK OIL FIELD SOURCES

Pollutant	Net Emissions Increase (t/y)	Significant Level (t/y)
CO	3,006	100
NO_x	15,402	40
SO_2	99	40
PM	373	25
VOC	64	40*

*VOC (Volatile organic compound) emissions were conservatively assumed to be 10 percent of total hydrocarbon emissions.

Heaters

Natural gas firing is proposed as BACT.

Other Facilities

In addition to the major emission sources (turbines and heaters), a refuse incinerator and a flare are included in the proposed facility. The incinerator will combust about 1300 pounds per hour of general refuse. The flare will combust the off-gases from the small crude oil topping unit. No controls are proposed as BACT for the crude oil topping unit and incinerator.

5.2 Alternative Systems Capable of Achieving Lower Emission Rates and Reasons for Their Rejection

5.2.1 Combustion Turbines

One of the best systems for turbines, from an NO_x emissions limitation standpoint, is the injection of water or steam (EPA, September 1977, p. 4-69). However, this control method is highly impractical on the north slope from the standpoint of environmental impacts, economic impacts, energy impacts, and engineering feasibility. The associated problems stem chiefly from the scarcity of freshwater, the extreme cold, and the fragility of the tundra. Because of these problems, extensive documentation has been compiled to support using dry NO_x controls for Prudhoe Bay combustion-turbines. This documentation is summarized in correspondence dated August 15, 1978, from W. P. Metz, Senior Environmental Engineer, Atlantic-Richfield Company, Alaska Region, to Mr. Paul Boys, U.S. Environmental Protection Agency, Region X.

The most promising systems from the standpoint of minimizing NO_x emissions from combustion-turbines, while maintaining a high fuel-to-power efficiency, are the dry controls

being incorporated into combustion chamber design. These controls are effective in reducing thermal-NO_x production, and when combined with a fuel containing little or no organic nitrogen, this system will meet the 150 ppmv limit stipulated by the proposed NSPS for combustion-turbines in rural petroleum production facilities (Federal Register 1978, p. 26385).

A low NO_x emissions rate is not the only reason for choosing natural gas firing as representing BACT. If this analysis were to include firing with oil, it would show that oil firing would not only result in higher NO_x emissions, but also higher SO_2 and particulate emissions and would be less economical.

There are no superior demonstrated alternatives to gas-firing for reducing particulate emissions from combustion-turbines. Gas-firing represents the best available particulate emission control technology.

Hydrocarbon (HC) and carbon monoxide (CO) emissions from turbines can be decreased by increasing the flame temperature and the combustion chamber residence time, but this dramatically increases NO_x emissions (EPA, September 1977, pp. 3-104). Because of the relatively large quantities of NO_x produced compared to those of HC and CO, such a trade-off would not be justifiable. Therefore, "no control" represents BACT for CO and HC.

5.2.2 Process Heaters

BACT for the process heaters has been determined to be the use of natural gas (an intrinsically low-polluting fuel) along with normal good combustion practice and no air preheat. Use of natural gas will reduce the emissions of particulates and oxides of sulfur (SO_x) substantially, and will reduce oxides of nitrogen (NO_x) somewhat.

No alternative controls are available to reduce particulates, CO, HC, or SO_x below the levels achieved by firing natural gas. There are several systems which can theoretically be used to further reduce NO_x emissions, but these systems are not warranted on the small heaters proposed for this facility (Evans, January 1978; Siddiqi, October 1976, pp. 94-97).

NO_x emissions from heaters can be further controlled by use of low-excess-air firing, off-stoichiometric combustion, low-NO_x burners, flue gas recirculation, and stack gas treating. Low-NO_x burners are the most commonly used. It was determined in the BACT analysis for the PWI/LPS/AL and Waterflood permits (Permit Nos. PSD-X-80-09 and PSD-X-81-01) that low-NO_x burners would be used on process heaters with a heat input greater than 43 MMBtu/hr, and that natural gas firing alone would suffice as BACT for heaters smaller than 43 MMBtu/hr. This guideline was used to determine BACT for the heaters at the proposed new facilities.